

Letters to the Editor

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BEYOND ROBOTICS AND VIRTUAL REALITY: IT'S TIME TO GO BACK TO THE PATIENT!

Dear Editor:

There is great scientific activity regarding robotics, virtual reality (VR), telehealth, and digital medicine.^{1–2} A “mischievous” point of view could tell that they are running after the real life, like the poor boy's finger in the Harlem Dam hole.

Evidence-based medicine, cost/efficacy ratio, and consensus papers are trying to put the hat over an almost 20-year-old spreading of these technologies in the field of neurorehabilitation, which usually has been based on low-tech, theoretical, and fascinating treatment approaches.

Different studies have established the difficulties of balancing effectiveness and economic sustainability for these newer forms of technology.³ A new player is aiming to put different needs: patients and caregivers with their sometimes confused but real wealth of information, as well as their first-hand experience of the significant difference between conventional and high-tech treatments. Most patients need to be treated for a long time, not necessarily as inpatients, and learn to ask for or travel to reach a healthcare facility confident with a modern technology

Progress is not linear. It is a continuous process, and technology does not deny this assumption. After 20 amazing years, it seems like a steady state has been reached. Everyone can easily experience this in everyday life with home technology (new models every six months, but not real disrupting new features that worth the cost).

The world can take a collective breath, and the medical world should try to expand its view, as it has the time to rethink the daily clinic in the light of the new robotic gym and patients' expectations. Healthcare services are becoming familiar with patient-centered medicine. Compared to a disease-focused biomedical approach, patient-centered care considers patient preferences, needs, and values, ensuring they guide all medical decisions in tandem with scientific evidence.⁵ It seems not too far from “Dr. Google,” but it can embody the end of a

“top-down model” in the physician–patient relationship.

We must remember that innovation technology has helped to accelerate the knowledge about what neuroplasticity really means, that early and intensive treatment should have been an unbearable burden for healthcare professionals without the help of robotics.^{1–3}

The two pillars of rehab, exercise repetition and knowledge of results/performance, had a great advancement thanks to robotics and VR (mainly in the early and acute phase of care). However, the lack of money the healthcare systems will face within the next years due to the COVID-19 pandemic, as well as the increasing numbers of patients to be treated because of aging, forces re-evaluation of most of the traditional and cheapest technologies.⁶

A new generation of instrumented treadmills and balance systems or bikes can fill the space next to the robotic gym to treat the same patient in a continuum of care and less severe patients in cheaper environments with less burden for the physiotherapists. The integration of music in an instrumented treadmill is showing its therapeutic powers in the daily treatment of neurodegenerative diseases. This is a necessary intermediate step toward a world of wearables, which are both efficient and cost effective.

The same applies for the so-called perturbation treadmills, which are being released from the labs as useful practicing tools in the prevention of falls in older patients.⁷ Interestingly, it has been shown that a shortened perturbation training program might be efficacious in improving responses to a novel overground slip but might not be as effective as protocols using greater number of slips.⁸ Moreover, lower body positive pressure support system (namely antigravity system) decreases weight-bearing and ground-reaction forces with potentially positive effects on qualitative gait indices, as demonstrated in patients who have had strokes.⁹

While waiting for the next generation of “high-tech,” when artificial intelligence and machine learning will be something realer than a plan to obtain grants and be part of everyday lives, too, these “old” tools can be supported and deeply enriched by the contribution of

functional magnetic resonance imaging (fMRI) and dynamic EEG.

It is known that using high-tech can be more effective with augmented feedback, like visual or acoustic cues. The latter include more engaging tools, such as “informed music,” which is widely distant from the old, boring metronome and can build new efficient functional pathways in a damaged brain. With this aim, it has been demonstrated that the usefulness of cueing strategies during gait training lays in the reshape of sensorimotor rhythms and fronto-centroparietal/temporal connectivity.¹⁰ Moreover, restoring the internal timing mechanisms that generate and control motor rhythmicity might depend on a contribution of the cerebellum.¹⁰ This provides rehabilitators new perspective when looking at the contribution of musical cues in the daily clinic not only for patients with Parkinson's disease and for many other neurodegenerative disorders.¹¹ These new therapies could be more easily be tailored to patient's ability/disability and needs.

Is this too optimistic? Why not? But, what better way to use the tragedy we are experiencing than to stop, check, and think to the better way to restart? A great future for neurorehabilitation is likely waiting.

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With regards,

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